Annealing Effect On Ultraviolet Sensor Performance With Porous Silicon Based

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***Abstract*— Nowadays, most semiconductor industries apply silicon-based material in developing advanced electronic device. Concerns with heat management of electronic devices which getting worst day by day, the nanostructures technologies were introduced in order to overcome the problem. The nanostructures development on bulk crystalline silicon known as porous silicon which could be produced via anodization method. In this study, the anodized porous silicon was annealed at temperatures of 200°C up to 800°C for the research purpose of annealing effect on ultraviolet sensor performance. The structures of porous silicon were analyzed via FESEM and XRD characterization in order to identify the morphology and crystallinity of porous silicon. Then, the ultraviolet sensors were produced and the sensors performance were analyzed. After post-annealing treatment, the anodized porous silicon has the strongest crystalline peak at 600°C and 800°C, while below 400°C, the porous silicon samples have a broadened XRD peak around 2θ = 33°. However, our experimental results show that an ultraviolet sensor which anneal at temperature 200°C have the best sensing performance.**

Keywords*— *porous silicon, anodization, annealing, ultraviolet sensor

I. INTRODUCTION

In advanced electronic device development nowadays, the reduction of chip size and increase in performance has resulted in a large power density. The heat management of this chip is one of the limiting factors in the production of advanced electronic design. Therefore, the need to develop better cooling solutions is paramount importance to ensure smooth chip performance and improve the package reliability. Silicon is widely used as a chip substrate in developing sensor due to it is suitability in sensor fabrication. Therefore, bulk silicon is used to develop ultraviolet sensor and many improvements experimentally had been done in order to optimize the sensor performance especially in term of heat management.

The development of nano-structures such as nano-porous and nano-tubes has modified the properties of bulk silicon in order to increase the surface area per volume ratio, which is useful for the heat dissipation. One of the techniques that had been discovered by scientists was the development of porous structure on the surface of bulk silicon [1]. It is decided that the method should be a high throughput, low cost, and low energy intake. This is attributed to phonon confinement in the porous silicon nanostructures and phonon scattering at porous silicon large internal surface [2].

II. MATERIAL AND CHARACTERIZATION

A. Synthesizing Porous Silicon via Anodization

Porous structure could be produced on the surface of bulk crystalline silicon via anodization method. The increasing of the surface area per volume ratio of the crystalline bulk silicon led to the improvement of thermal properties of the material which is useful for heat dissipation of ultraviolet sensor. The pore size is very appropriate for sensitivity adjustment for sensing application [3]. The size of the pores can be widely varied by adjusting some of parameters during anodization process which is depend on the application requirement for the project such as selecting proper electrolytes, changing the bias voltage and anodizing time. [3] [4]. The most common electrolyte that been used by physicians and scientists in order to fabricate porous structure on the surface of bulk crystalline silicon was the mixture of hydrofluoric acid (HF) and methanol solution [5] [6] [7]. However, the electrolytes had been modified and diversified by physicians and scientists recently which could produce porous structure on the surface of bulk crystalline silicon with either the same or different surface morphology. In addition, the concentration of hydrofluoric acid (HF) could affect the degree of porosity of bulk crystalline silicon [8] [9] [10].

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